

Lunar and Meteorite Sample Disk for Educators. S. Foxworth¹, M. Luckey², J. Allen³, B. McInturff¹, A. Kascak¹, ¹Jacobs JETS Contract, NASA Johnson Space Center, Mail Code XI3, Houston, TX 77058, Suzanne.m.foxworth@nasa.gov, ²NASA Johnson Space Center, Houston, TX 77058, ³NASA SSERVI College of Charleston, Charleston, SC.

Introduction: NASA Johnson Space Center (JSC) has the unique responsibility to curate NASA's extra-terrestrial samples from past and future missions. Curation includes documentation, preservation, preparation and distribution of samples for research, education and public outreach. Between 1969 and 1972 six Apollo missions brought back 382 kilograms of lunar rocks, core and regolith samples, from the lunar surface. JSC also curates meteorites collected from a US cooperative effort among NASA, the National Science Foundation (NSF) and the Smithsonian Institution that funds expeditions to Antarctica. The meteorites that are collected include rocks from Moon, Mars, and many asteroids including Vesta. The sample disks for educational use include these different samples. Active relevant learning has always been important to teachers and the Lunar and Meteorite Sample Disk Program provides this active style of learning for students and the general public. The Lunar and Meteorite Sample Disks permit students to conduct investigations comparable to actual scientists. The Lunar Sample Disk contains 6 samples; Basalt, Breccia, Highland Regolith, Anorthosite, Mare Regolith and Orange Soil. The Meteorite Sample Disk contains 6 samples; Chondrite L3, Chondrite H5, Carbonaceous Chondrite, Basaltic Achondrite, Iron and Stony-Iron. Teachers are given different activities that adhere to their standards with the disks. During a Sample Disk Certification Workshop, teachers participate in the activities as students gain insight into the history, formation and geologic processes of the moon, asteroids and meteorites.

Certification Workshops: Workshops are set at 6-7 hours for both Lunar and Meteorite. A 4 hour workshop certifies the borrower for only Lunar or Meteorite, not both. Educators are led through a series of activities that highlight the key early solar system processes; accretion, differentiation, impact and volcanism. All these processes helped to shape our solar system and are embedded in education standards. Participants conduct activities to gain a better understanding. Delivery is also modeled for participants. There is an open discussion at the end of each activity to summarize the content and allow for collaboration among the educators on the delivery methods. The Educators can then go back to their classes and teach the concepts more confidently. There were 543 Sample Disks borrowed by educators across the United States during 2014¹.

Why use Active Learning? There has been an emphasis for active learning in education since the early 80's in public education. Studies in early 1978 by J. Hartley and I. Davies [2], indicated students that are engaged in active learning are cohesive and this allows students a safe environment in which they can ask questions without ridicule from their peers [4]. Active learning engages students in their own learning [3]. Students experience retention of the learned material when active learning is practiced in the class. J. Hartley and I. Davies found that during a classroom lecture student attention dropped through the lecture and this resulted in only 20% retention rate at the end of the lecture [2]. With the demands of present standardized testing, retention of content needs to be much higher.

Many of the Lunar and Meteorite activities incorporate active learning and can result in a higher retention of the content. Educators participate in the Lunar and Meteorite activities as if they were students. This allows educators to experience and model the learning. After each activity, they are allowed to reflect on the process of the content and delivery of the content. Teacher collaboration takes place during this time and many ideas are exchanged during the workshop. This also allows educators to bring up any issues and receive resolution.

Borrowing the Sample Disks: Educators receive security training during the workshop. The sample disks they borrow are priceless treasures, collected during the Apollo Missions. The Meteorite Sample Disks contain samples collected from Antarctica, Mexico, Africa and USA. Educators can request Lunar or Meteorite Sample Disks or both at the same time. Sample disks are shipped to the educator for a loan period of two weeks. Education resources are provided to help assist with activity planning.

References: [1] Johnson Space Center Astro-materials Research and Exploration Science Data Center data provided via email communications, January 2015. [2] Hartley, J., and Davies, I., "Note Taking: A Critical Review", Programmed Learning and Educational Technology, Vol. 15, 1978, pp.207-224. [3] Prince, M. "Does Active Learning Work? A Review of the Research, Journal of Engineering Education, Vol. 93, July 2004, pp.223-231. [4] Houston, L. Fraser, B., Ledbetter, C., "An Evaluation of Elementary School Science Kits in Terms of Classroom Environ-

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